Supergen Marine (UKCMER) highlights

An efficient, experimentally validated, open source turbine array CFD model

Ian Masters, Alison J Williams
Swansea University

Funded by:

EPSRC (2015-2019)

EU Interreg (2019-2022) Project Selkie

Computational Fluid Dynamics approach

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EU Funds: Ireland Wales Programme 2014-2020

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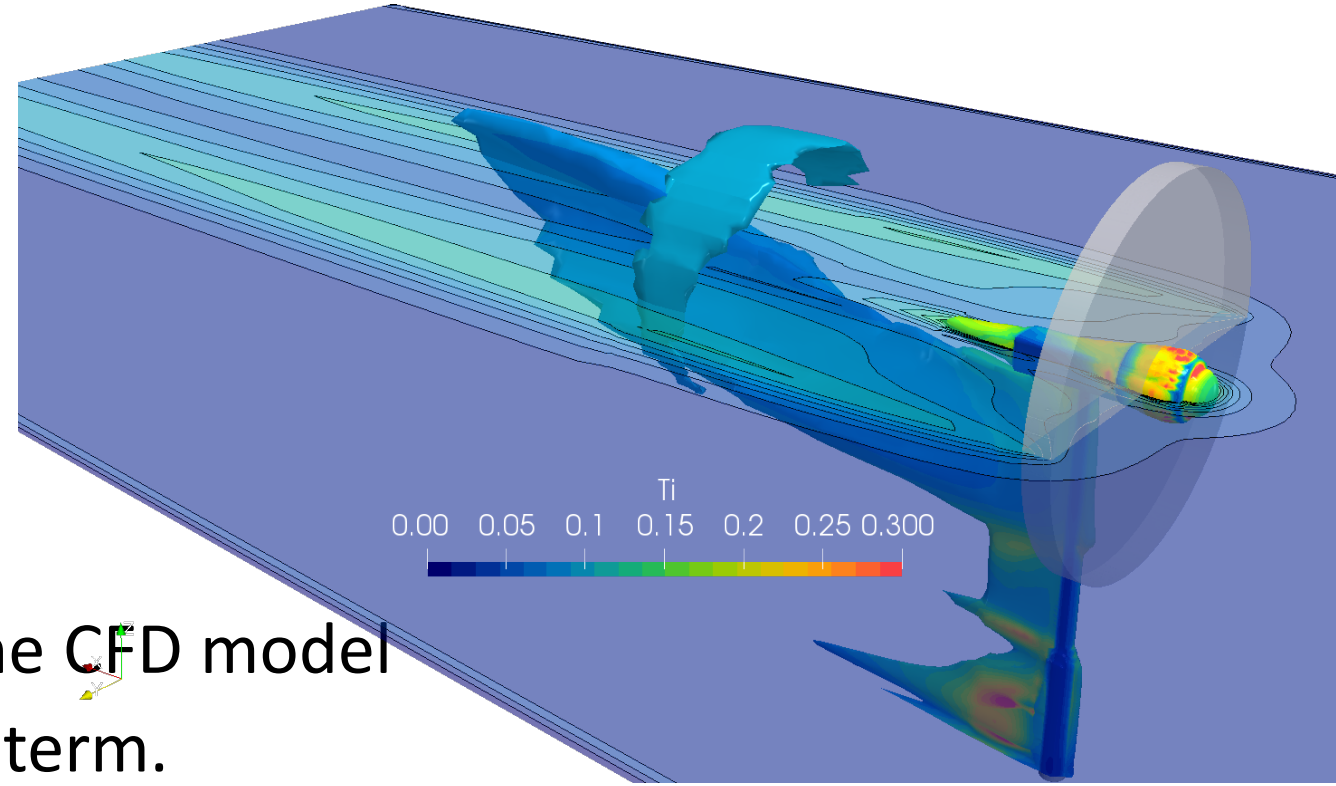

RANS finite volume CFD model

Rotor disk source term.

OpenFOAM implementation

GitHub **open source** distribution

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Selig et al. NREL Phase 3 Wind Turbine

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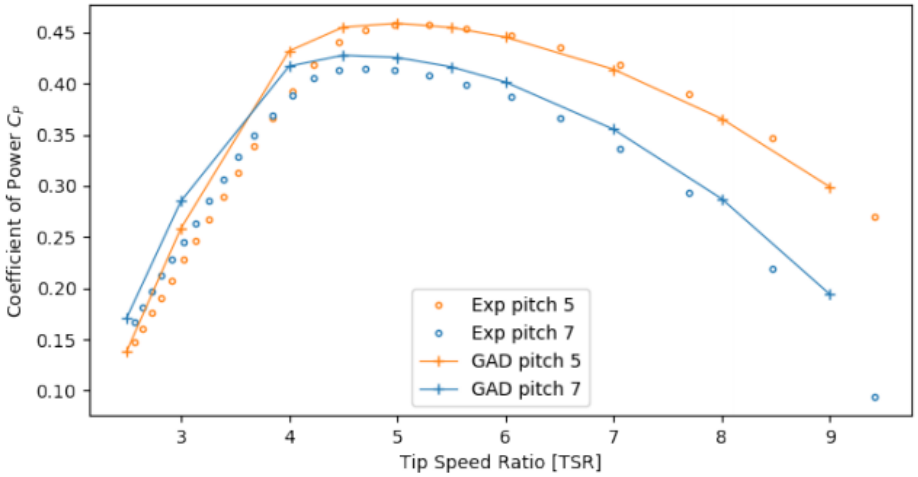

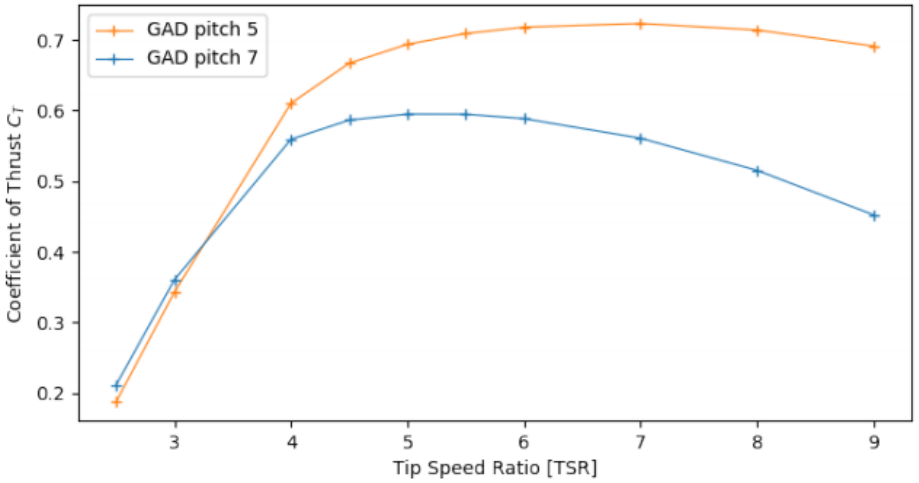

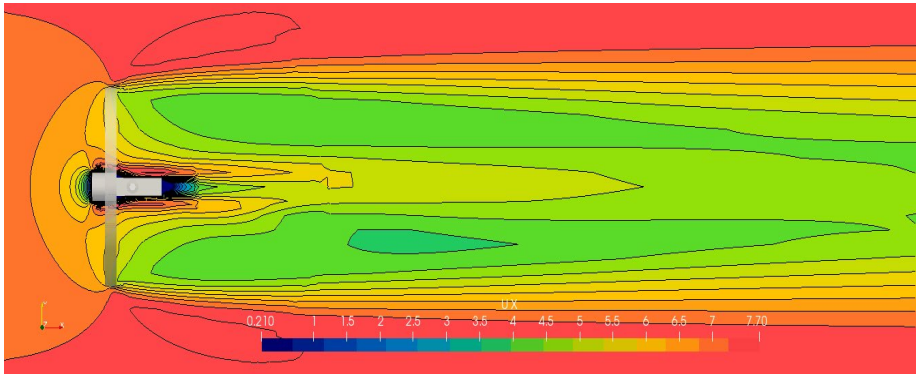

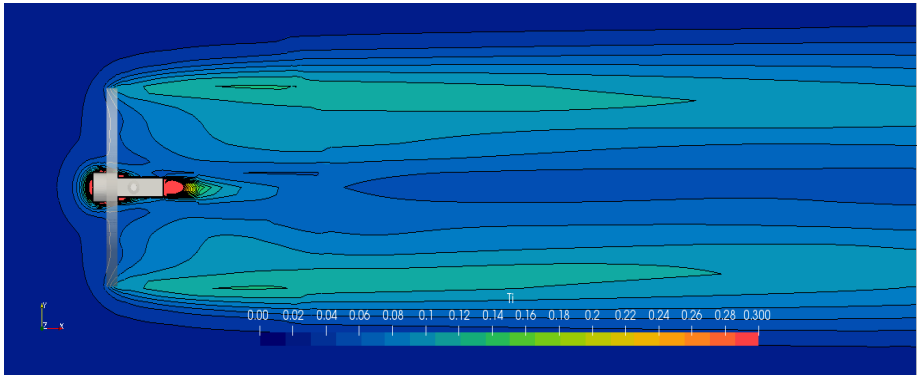

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The FloWave Facility

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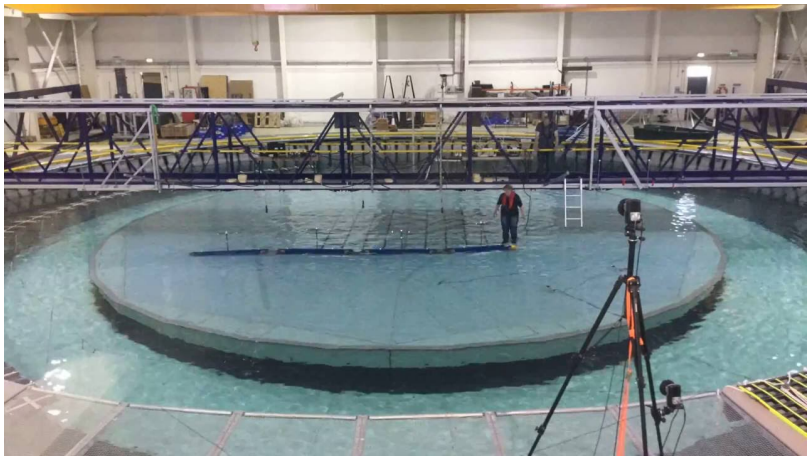
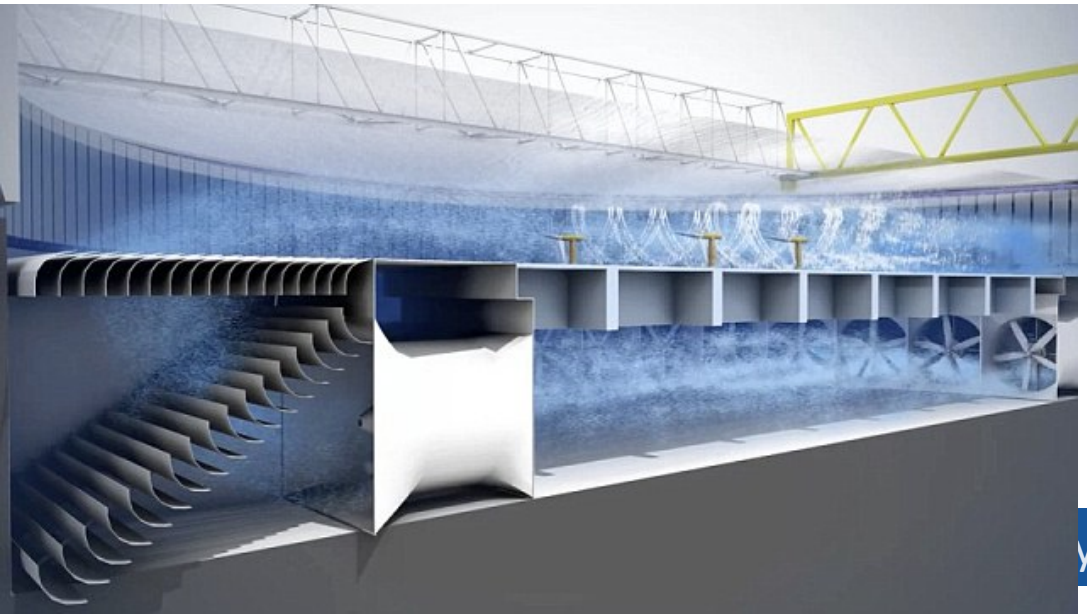
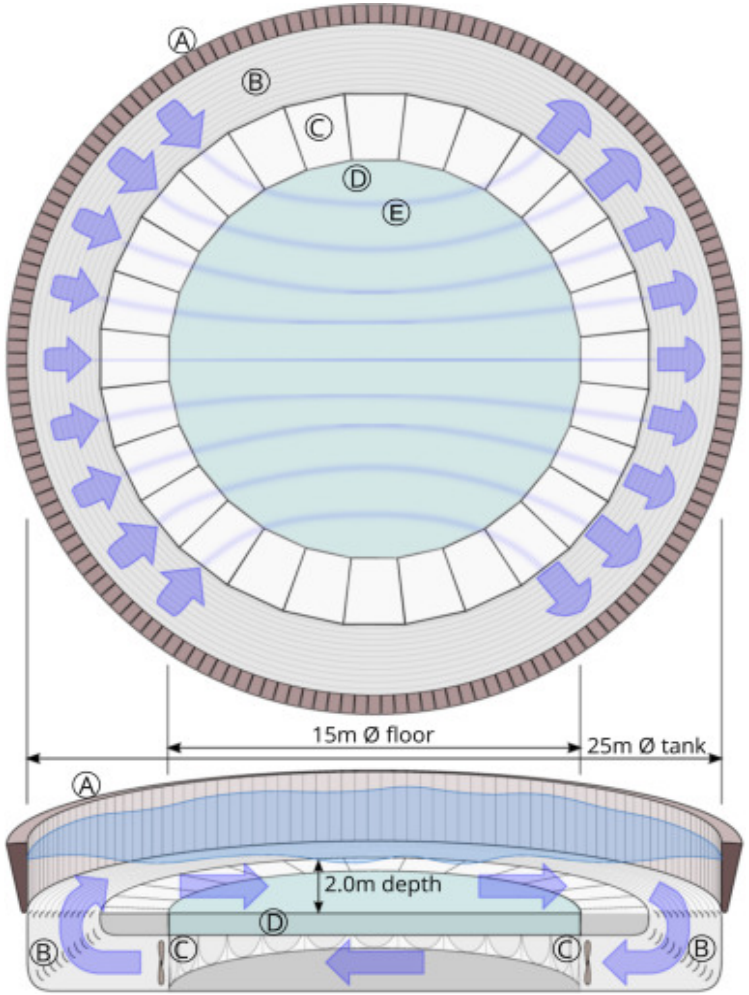


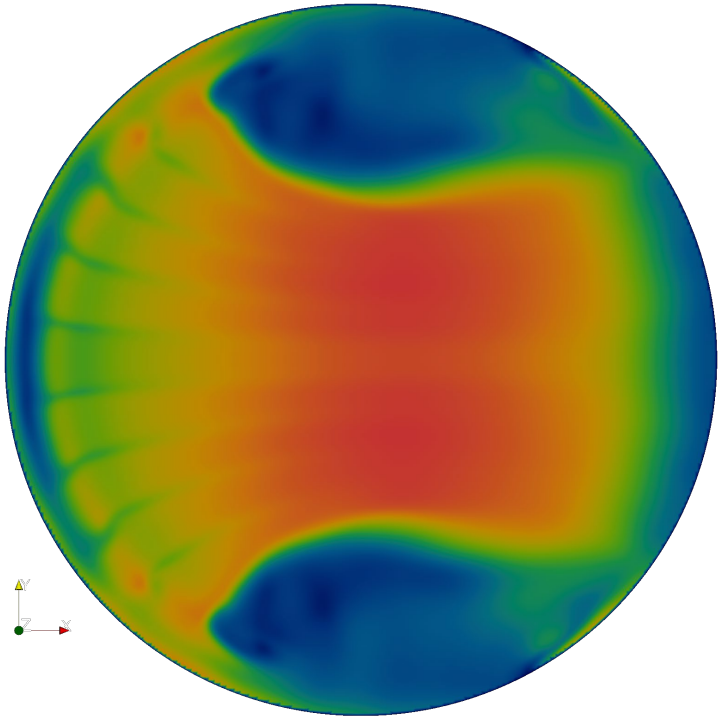


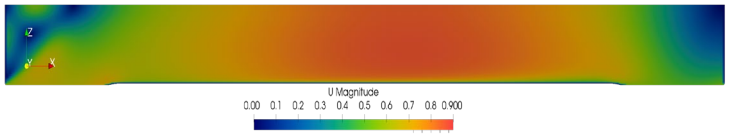


y bit.ly/SoftwareJobMarineEnergy

Simulation of the Facility

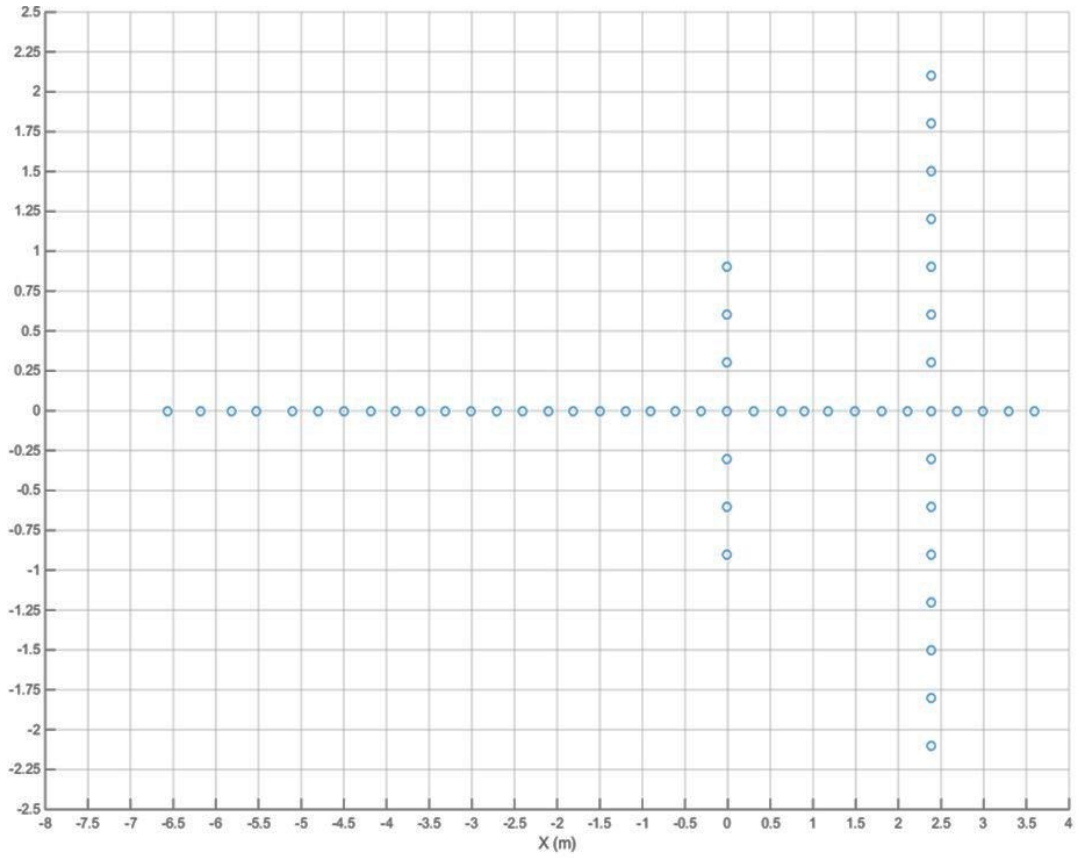
- Model type.
- Model equations.
- Boundary conditions.
- Initial conditions.
- Initial results.





Simulation of the Facility

- Measurement Locations shown
- Hub height 1 metre
- Flow direction
- Cross section at rotor location and wake



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Simulation of the Facility

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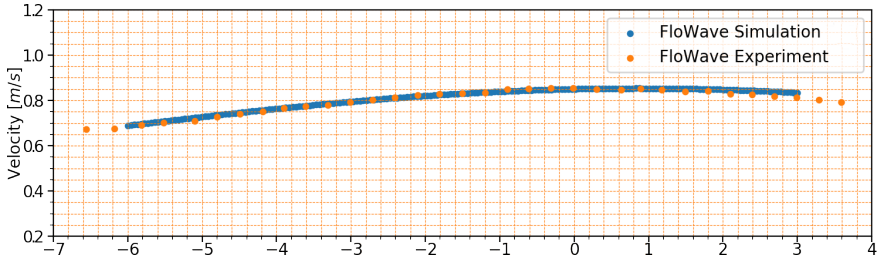

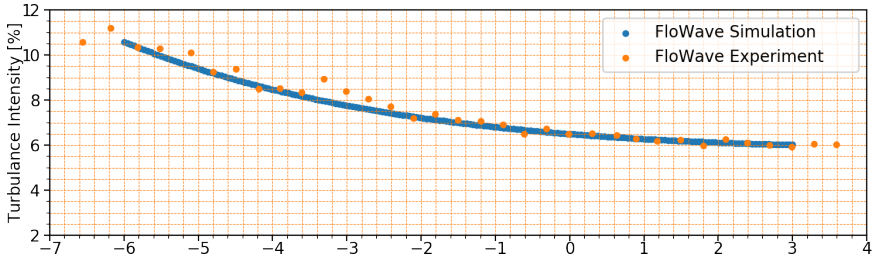

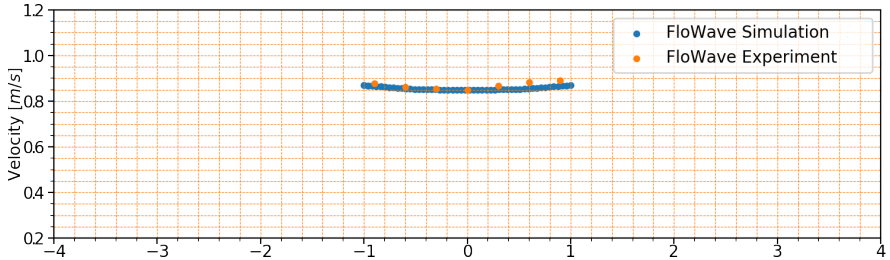

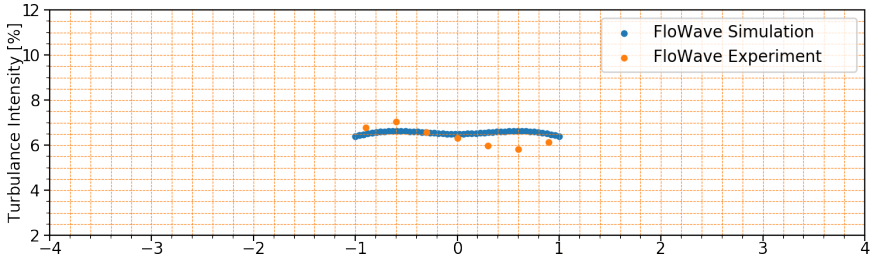

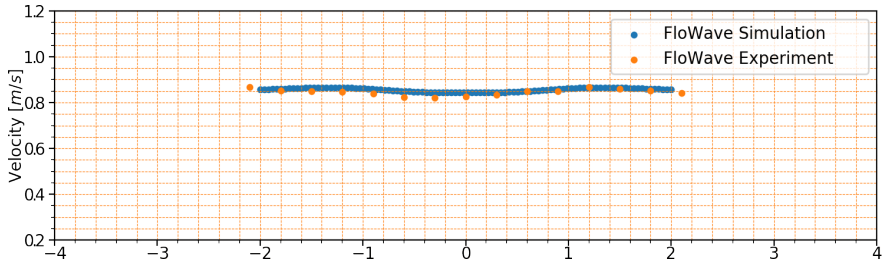

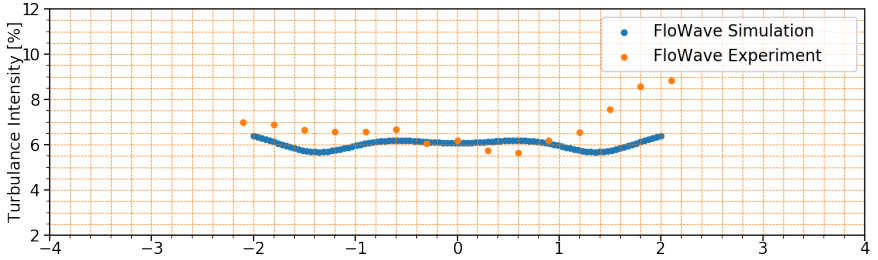

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One turbine results

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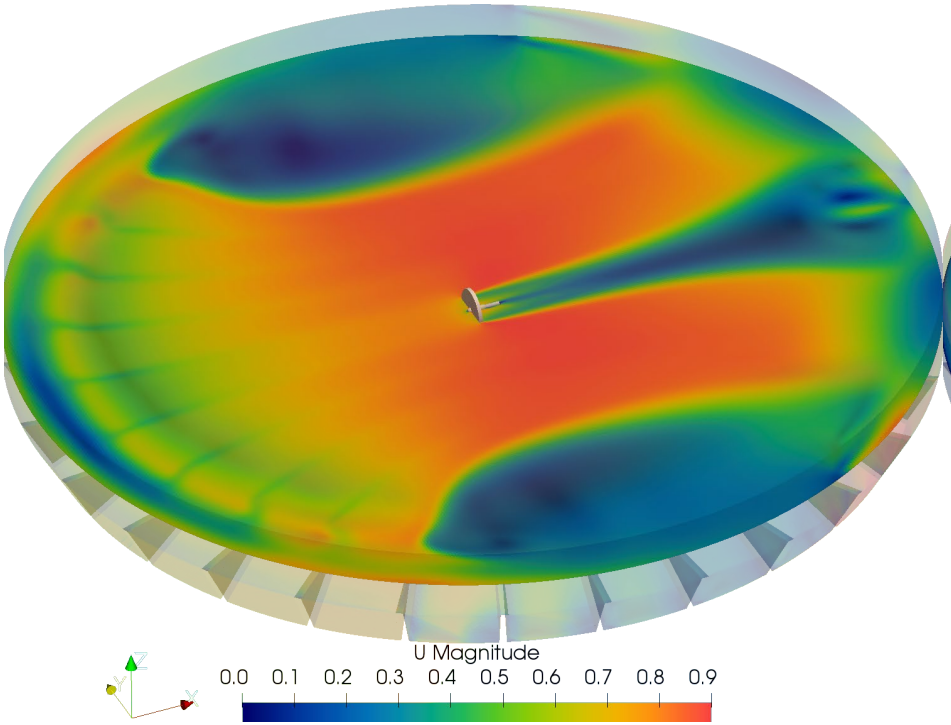

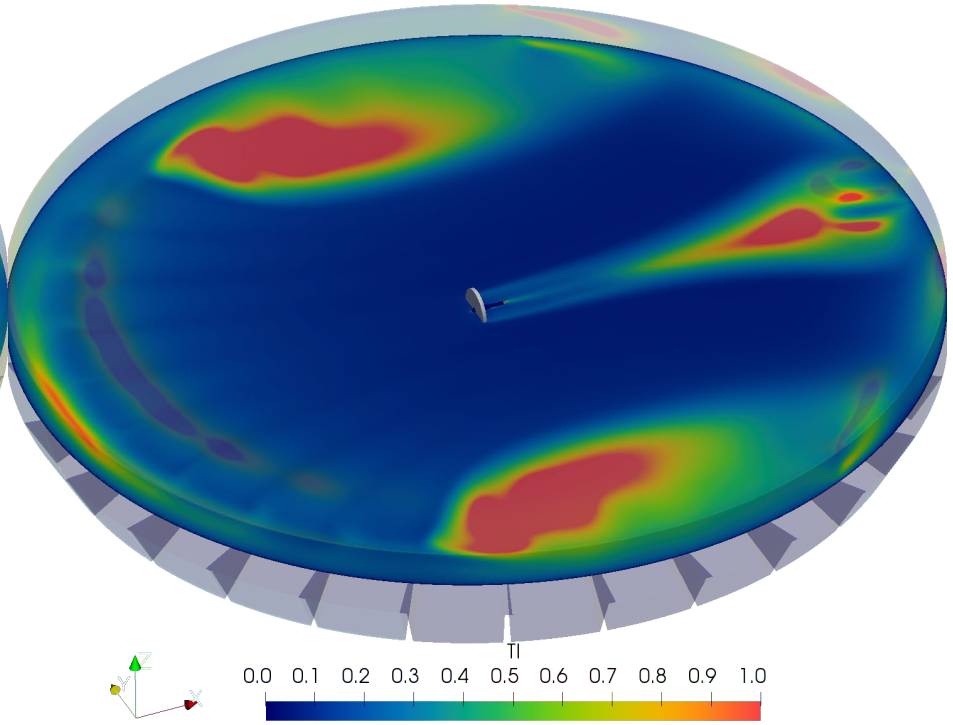

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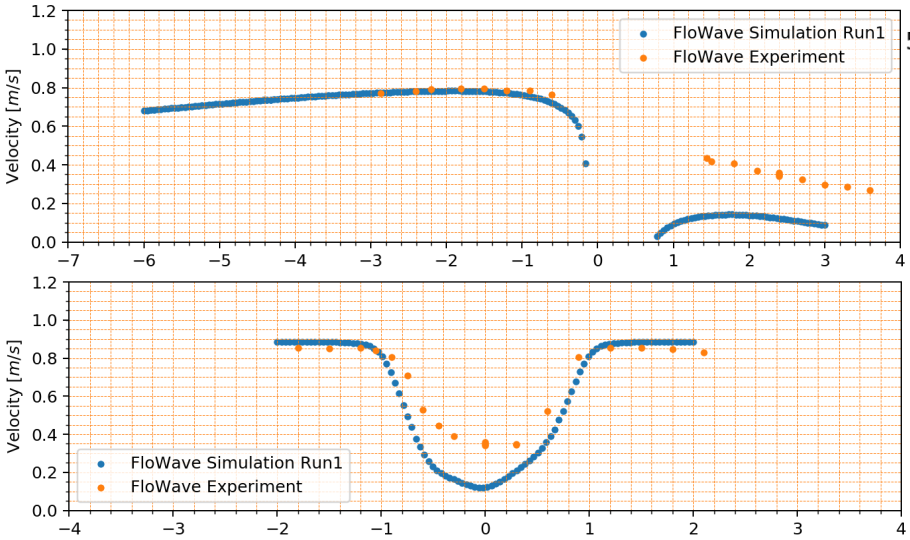
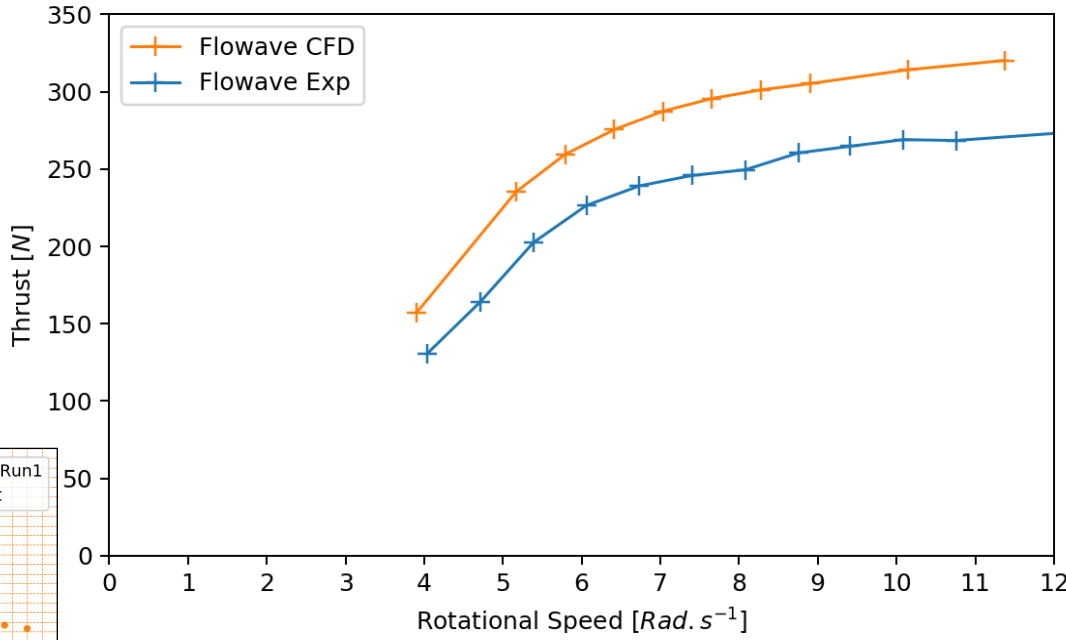
Rotor results

- Upstream velocity good fit.
- Downstream excessive deficit.
- Wake section shows same result.

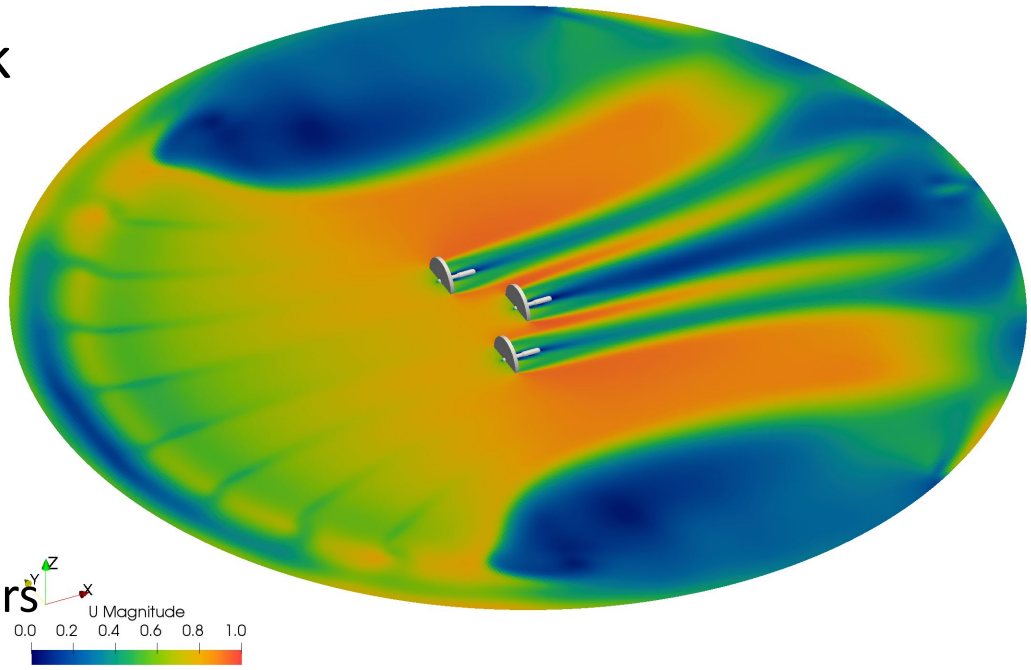




- Rotational speed 7.4 rad/s.
- Thrust curve trend OK.
- Thrust too high? 240N vs. 300N.
- Pitch angle not set correctly.

3 rotor model

- Existing tank model
- 3 identical turbines
- Generalised Actuator Disk for each rotor
- CL, CD curves chosen for Reynolds number
- Downwash for tip loss correction
- Results:
  - Acceleration between rotors
  - Wake follows tank streamlines



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Velocity and Turbulence

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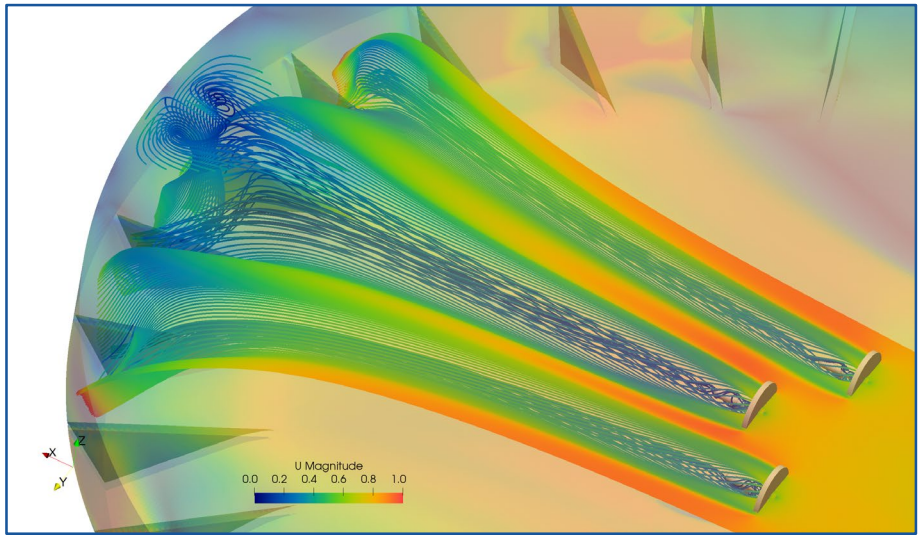

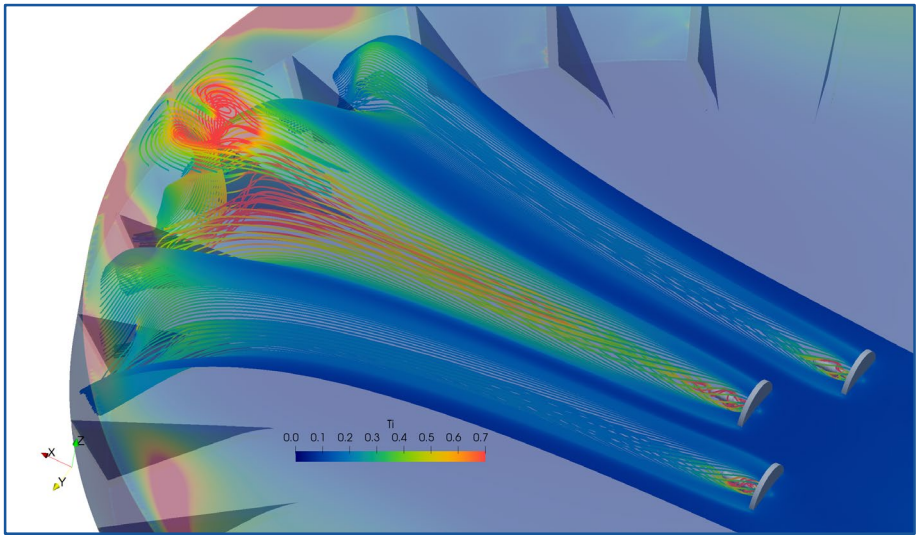

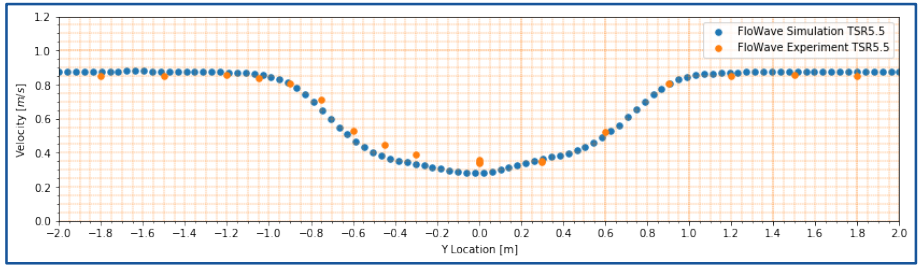

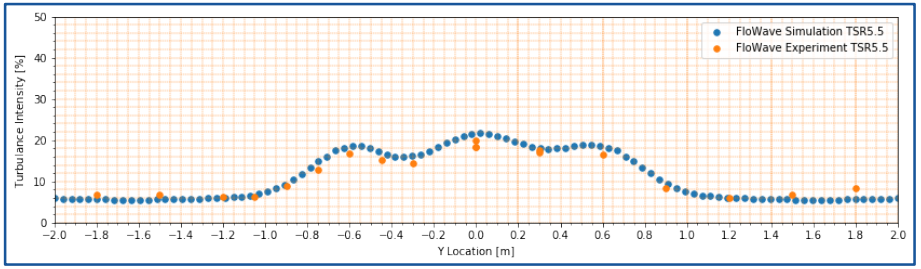

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Open Source CFD tool

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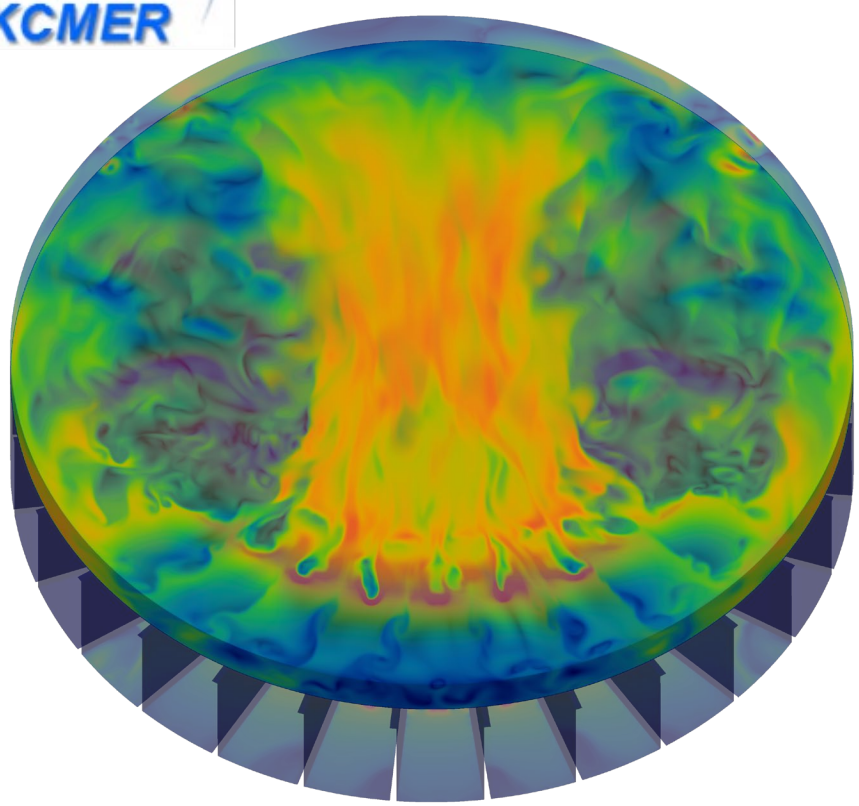

- Thanks to EPSRC for funding so far
- 2019-2022 Project Selkie
- TWO RESEARCH JOBS AVAILABLE
- Turbine CFD
  - OpenFOAM Array modelling
- Software support
  - Github, Docs, training, benchmarks

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